Linearized FUN3D for Rapid Aeroelastic and Aeroservoelastic Design and Analysis, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

The overall objective of this Phase I project is to develop a hybrid approach in FUN3D, referred herein to as the Linearized FUN3D, for rapid aeroelastic and aeroservoelastic (ASE) design and analysis. The Linearized FUN3D solves a linearized Euler equation with a transpiration boundary condition using the FUN3D steady N-S solution as the steady background flow to efficiently generate a Reduced Order Model (ROM) in the form of the frequency-domain Generalized Aerodynamic Forces (GAF) matrices due to the structural modes, control surface kinematic modes and gust excitation. The Linearized FUN3D can generate an accurate unsteady aerodynamic solution in the small perturbation sense about a nonlinear steady flow condition. It also can avoid the moving mesh problem associated with applying the exact N-S boundary condition which requires additional computational resources, and becomes very complex in dealing with the discontinuous displacement in mode shapes such as the control surface modes for which generating a computational mesh could be a very tedious effort. In order to enable the Linearized FUN3D to perform frequency-domain open-loop and closed-loop aeroelastic analysis and to generate a plant model in terms of state space equations, several modules in ZAERO, ZONA's flagship commercial software for aeroelastic, ASE, and gust analysis, will be incorporated into the Linearized FUN3D. One can directly import such a plant model into MATLAB to design a flutter suppression and Gust Loads Alleviation (GLA) control system using the modern control design schemes available in MATLAB. The accurate flow field prediction of the wing pressures when a spoiler is deployed is currently beyond the capabilities of the existing aeroservoelastic codes. The wind tunnel measured unsteady pressures on the Benchmark Active Controls Technology wing will be selected to validate the proposed Linearized FUN3D for unsteady aerodynamic prediction due to spoiler oscillations.

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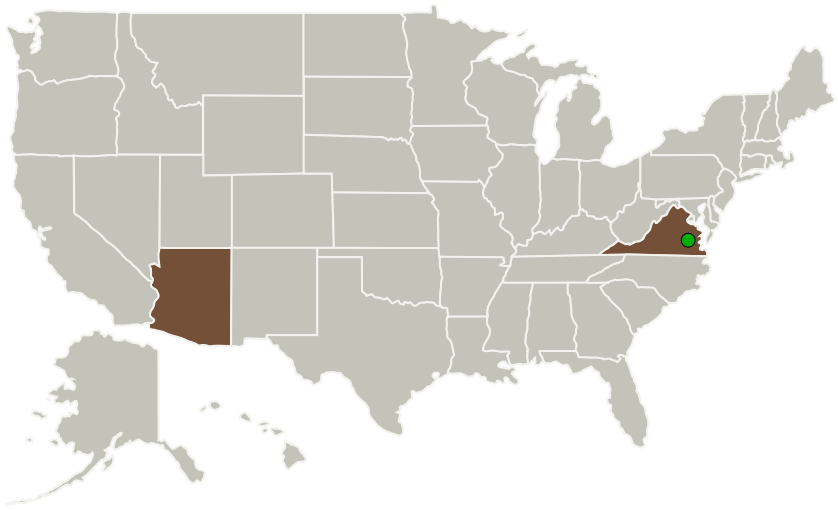
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
ZONA Technology, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Scottsdale, Arizona
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Arizona	Virginia

Project Transitions

June 2014: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

ZONA Technology, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

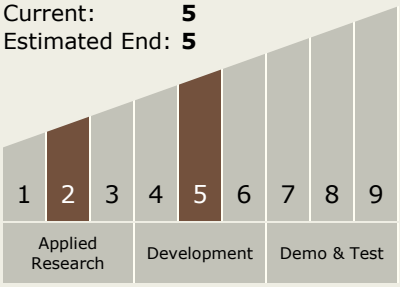
Carlos Torrez

Principal Investigator:

Shuchi Yang

Technology Maturity (TRL)

Start: **2**
Current: **5**
Estimated End: **5**



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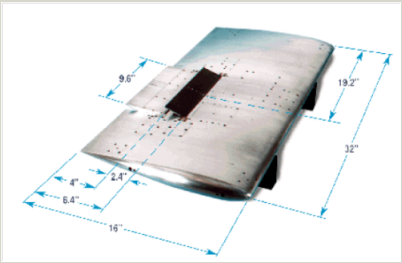
December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140505)*

Images



Briefing Chart
Linearized FUN3D for Rapid Aeroelastic and Aeroservoelastic Design and Analysis, Phase I
(https://techport.nasa.gov/image/128491)

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.1 Avionics Component Technologies
    - TX02.1.3 High Performance Processors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System